Chapter 9
General Wastewater System Design Deficiencies

9-1. General

Design deficiencies of the several treatment processes mentioned in Chapters 5 and 8, where they occur, limit the performance of wastewater treatment plants. Elimination of deficiencies in the design phases of a project ensures that the final construction will incorporate the maximum number of operational conveniences for plant flexibility and process control. Deficiency reduction will permit more operable facilities which can be maintained at less cost and ensure that regulatory effluent standards are consistently met. Typical deficiencies in the design of various wastewater treatment systems are summarized in the following paragraphs. For more details consult USEPA-5.

9-2. Overall Considerations

a. *Health/Safety/Security*.

(1) Lack of hoists over larger pieces of equipment.

(2) Lack of walkways around tanks, limiting operator access.

(3) No provisions for moving equipment and supplies from one location to another.

(4) Use of fixed louvers in buildings that cannot be shut during winter weather conditions.

(5) Inadequate consideration of means to remove equipment for repair or replacement.

(6) Inadequate communication capabilities between buildings and process areas.

(7) Lack of all-weather roads to lift stations.

(8) Inadequate clearance around equipment for maintenance functions.

(9) No ladders or steps in manholes.

(10) Inadequate plant lighting.

(11) Stairways without non-skid surfaces.

(12) Inadequate hand railing and kick plates.

(13) Inadequate fencing and/or security gate around site.

(14) Use of air headers as guard railing at small package-plant type.

(15) Stairs inclined at too steep an angle.

(16) Guard railing not provided around ground-level tanks.

(17) Stairways provided with only one handrail.

(18) Valve handles located in unsafe areas.

(19) Dangerous chemicals not stored in separate areas.

(20) Hand rails and grating not secure.

(21) Stairs or steps not painted bright colors.

(22) Wet floors in some areas (pump rooms and pipe galleries) are slippery.

(23) Ladders in manholes and concrete tanks not secure.

(24) Hazardous areas not well defined.

(25) Permanent access platforms required for maintenance not provided.

(26) Interior building surfaces not painted with bright, easily-cleaned paints.

(27) Inadequate consideration of local weather conditions and their impact on the accessibility of a plant site.

(28) Failure to color code interior chemical feed lines.

(29) Inadequate consideration of spill prevention plan.

b. Pumps.

(1) Lack of spare pumps.

(2) Use of single-speed pumps where variable speed units are required.

(3) Pumps located above the normal water level, making them difficult to prime.

c. HVAC.

(1) Use of fixed louvers in buildings that cannot be shut during winter weather conditions.

(2) Lack of ventilation promotes corrosion of electrical components.

(3) Inadequate consideration of odor development and control.

(4) Inadequate consideration of ventilation requirements in confined spaces.

d. Layout.

(1) Inadequate flexibility to bypass units.

(2) Relative layout of process units and interconnecting piping not optimized.

(3) Layout of unit processes does not allow for future expansion of plant.

(4) Control panels not easily accessible (i.e., too high or placed in close quarters).

(5) Lack of flexibility to operate at low-flow start-up conditions.

(6) Electrical control panels located below ground where exposed to flooding.

(7) Inadequate consideration of potential freezing problems of plant components.

e. Valves.

(1) Inadequate valving for maximum flexibility and proper maintenance.

(2) Valves not operable from floor level.

(3) Lack of air bleed-off valves at high points in pump discharge lines.

(4) Lack of mud valves in tanks.

(5) Inadequate provisions for pressure relief around positive-displacement pumps.

(6) Inadequate consideration of the type of valve or gate used.

(7) Inadequate provisions for manual valve operation during emergency conditions.

f. Piping.

(1) Insufficient color coding of pipes and valves.

(2) Insufficient number and poor placement of high-pressure hose hydrants throughout plant.

(3) No provision for water tap at top of above-ground package units.

g. Equipment.

(1) Inadequate stand-by equipment.

(2) Stand-by generator either not provided or undersized to run all essential equipment during emergencies.

h. Sampling.

(1) Lack of sampling taps at pumping stations.

(2) Inadequate provisions for sampling of individual processes.

(3) Lack of influent and/or composite sampler.

i. *Sumps/Drains*.

(1) Inadequate provisions for draining tanks and sumps.

(2) Floor drain piping system undersized.

(3) Drains from buildings discharge into basins with normally (or periodically) high-water levels, causing drains to back-up.

(4) Lack of drains on chemical mix tanks.

(5) Lack of sumps in dry wells.

j. *Loadings*.

(1) Foam sprays not concentrated in basin corners where foam buildup occurs.

(2) Design based on average flow and BOD_5 and SS loadings with no recognition of peak conditions.

(3) Lack of tank dewatering systems to permit rapid servicing of submerged equipment.

(4) Excess oil from stationary units not contained.

(5) Inadequate scum handling and disposal system.

k. *Hydraulics*.

(1) Undersized scum pits.

(2) Inadequate consideration of pumping system design and/or fluid characteristics, resulting in pump cavitation.

(3) Improper water pressure supplied to rota-meters.

l. *Instrumentation.*

(1) Lack of flow metering device on chemical feed lines.

(2) Pressure gauges not located on inlet side of back-pressure relief valves, making it difficult to check and/or adjust the valve.

(3) Lack of pressure gauges on plant pumps.

(4) Inadequate number of flow meters.

m. Electrical.

(1) Absence of electrical outlets on top of treatment units.

(2) Electrical design does not have a power factor correction.

(3) Infrequent use of high-efficiency lighting sources.

(4) Motors oversized for future growth which never materializes, resulting in motors operating at less efficiency with lower power factors.

(5) Insufficient use of high-efficiency motors.

(6) Electrical quick-disconnect plugs not provided with submerged pumps to facilitate rapid replacement.

(7) Electric cut-off switches not locally mounted at individual pieces of equipment.

n. Noise.

(1) Inadequate noise abatement in various plant areas (i.e., blower, pump, and dewatering rooms, etc.).

(2) Inadequate consideration of noise control.

o. Other.

(1) Inadequate location of thrust blocks on pipe lines, particularly where couplings are involved or where automatic valves are located.

(2) Lack of cathodic protection for steel tanks.

(3) Lack of foam control system where required.

9-3. Conventional Design

a. Preliminary treatment processes—general.

(1) Inadequate consideration of pumping system design and/or fluid characteristics, resulting in pump cavitation.

(2) No provisions made to allow periodic cleaning of the influent wet well.

(3) Inadequate consideration of possible development of septic conditions in channels and splitter boxes.

(4) Lack of flexibility in disinfection systems to permit pre-chlorination for odor control or return sludge chlorination for control of bulking.

(5) High-water alarm system not provided.

b. *Primary treatment processes—general*.

(1) Lack of flexibility to operate at low-flow start-up conditions.

(2) Poor hydraulic and solids distribution among identical units operating in parallel.

(3) Undersized scum pits.

(4) Insufficient or inflexible sludge return and/or wasting pumping capacity.

(5) No mixing provided in scum tank to keep scum mixed during pumping.

(6) No positive method of removing scum from center well of clarifiers.

c. *Secondary treatment processes—general*

(1) Lack of walkways around tanks, limiting operator access.

(2) Inadequate consideration of scum removal from plant.

(3) Inadequate provisions for sampling of individual processes.

d. *Residuals hauling—general.*

(1) Use of single-speed pumps where variable-speed units are required.

(2) Undersized scum pits.

(3) Insufficient or inflexible sludge return and/or wasting pumping capacity.

(4) Lack of tank dewatering systems to permit rapid servicing of submerged equipment.

9-4. Preliminary Unit Processes

a. *Manual bar screen.*

(1) Lack of provision to remove floating material.

(2) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(3) Inadequate consideration of proper disposal of coarse screenings and grit.

(4) Improper spacing of bars on bar screens.

(5) No provision for bypassing flow during maintenance.

(6) Improper velocity in bar screen chamber leading to grit deposition.

(7) Inadequate consideration of potential freezing.

b. *Mechanical bar screen*.

(1) Lack of provision to remove floating material.

(2) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(3) Inadequate consideration of proper disposal of coarse screenings and grit.

(4) Improper spacing of bars on bar screens.

(5) No provision for bypassing flow during maintenance.

(6) Improper velocity in bar screen chamber leading to grit deposition.

(7) Inadequate consideration of potential freezing.

(8) Inadequate timing of mechanical rakes.

c. *Comminutor*.

(1) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(2) Comminutor not located downstream of grit removal equipment, resulting in excessive cutting blade wear.

(3) No bar screen provided upstream for comminutor protection.

(4) No provision for bypassing flow during maintenance.

(5) No traps provided upstream of comminutor to still high velocity flows.

(6) Inadequate design permits grit deposits in control section of flow measurement device.

(7) Inadequate consideration of effect of waste material on mechanical reliability.

d. *Manually cleaned grit chamber*.

(1) Not locating grit removal and/or screening devices ahead of influent-pumps to protect pumps from clogging or excessive abrasion.

(2) Comminutor not located downstream of grit removal equipment, resulting in excessive cutting blade wear.

(3) Inadequate consideration of proper disposal of coarse screenings and grit.

(4) No provision for bypassing flow during maintenance.

(5) Inadequate velocity through process due to poor design.

(6) Improper flow-through velocity in grit chamber.

(7) Short-circuiting in grit chamber.

(8) Inadequate consideration of potential freezing.

e. Mechanically cleaned grit chamber.

(1) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(2) Comminutor not located downstream of grit removal equipment, resulting in excessive wear.

(3) Inadequate consideration of proper disposal of grit.

(4) No provision for bypassing flow during maintenance.

(5) Inadequate consideration of increased O&M and energy costs for grit collection process.

(6) Inadequate velocity through process due to poor flow control.

(7) Improper flow-through velocity in grit chamber.

(8) Short-circuiting in grit chamber.

f. Aerated grit chamber.

(1) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(2) Comminutor not located downstream of grit removal equipment, resulting in excessive wear.

(3) Inadequate consideration of proper disposal of grit.

(4) No provision for bypassing flow during maintenance.

(5) Inadequate consideration of increased O&M and energy costs for grit collection process.

(6) Improper flow-through velocity in grit chamber.

(7) Short-circuiting in grit chamber.

g. *Grit pumps*.

(1) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(2) Inadequate consideration of increased O&M and energy costs for grit collection process.

h. *Influent flow measurement*.

(1) Measurement control section not compatible with flow measurement device.

(2) Inadequate design of downstream channel slope and geometry causes back-up in control section.

(3) Inadequate design of obstructions downstream of control section induces inaccuracies in flow measurement.

(4) Inadequate consideration of debris in wastewater in selection of float for flow measurement.

(5) Flow meters located such that backwater elevation changes affect accuracy of meter.

(6) Inadequate consideration of diurnal flow patterns in sizing of flow measurement equipment results in measurement equipment being inaccurate at the high and/or low flow ranges.

(7) Inadequate approach channel length results in flow measurement inaccuracies.

(8) Inadequate consideration of humidity in influent structure results in inaccuracies to flow sensor.

i. *Raw wastewater pumping*.

(1) Inadequate selection of the number, size, and type of pumps.

(2) Inadequate provisions for removing scum from wet well.

(3) No provisions for odor control in wet well of lift stations.

(4) Not locating grit removal and/or screening devices ahead of influent pumps to protect pumps from clogging or excessive abrasion.

(5) No provisions to periodically clean the wet well.

(6) No bar screens provided for protection of mechanical components.

(7) Inadequate design of pumping station results in frequent cycling of units, causing flow surges in downstream processes.

(8) Lack of emergency overflow.

(9) Improperly sized wet wells resulting in long detention times and odor problems, or too short detention time and cycling of pumps.

(10) Lack of spare air compressor for bubbler system.

(11) Inability to back-flush influent pumps for cleaning purposes.

(12) Corrosive and/or explosive gases close to electrical motors and equipment.

(13) Lack of proper ventilation at lift station.

j. In-line and side-line flow equalization.

(1) Surface floating aerators do not allow basin to be dewatered.

(2) Inadequate or lack of facilities to flush solids and grease accumulations from the basin walls.

(3) Lack of facilities for withdrawing floating material and foam.

(4) Lack of emergency overflow.

(5) Lack of depth gauges provided on basins that operate at varying levels.

9-5. Primary Treatment Unit Process

a. Primary clarifier.

(1) Improper length-to-width ratios.

(2) Inadequate clarifier sidewater depth.

(3) Design includes a common sludge removal pipe for two or more clarifiers, resulting in unequal sludge removal from the clarifiers.

(4) Effluent weir not uniformly level.

(5) Improper baffling resulting in short-circuiting causing inefficient solids removal.

(6) Septic conditions resulting from overloading or incorrect sludge removal.

(7) Inadequate consideration of impact of waste secondary sludge pumping on clarifier loading.

(8) Inadequate consideration of impact of various trickling filter recirculation rates and strategies on clarifier loadings.

(9) Inadequate consideration of clarifier inlet design.

(10) Inadequate sizing of torque requirement for sludge removal mechanism.

(11) Heavy wear on scrapers due to grit accumulations.

b. Primary sludge removal.

(1) Flushing and cleanout connections for sludge line not provided.

(2) Primary sludge pumps located too far away from clarifiers.

(3) Inadequate provisions for preventing frequent maintenance resulting from stringy or fibrous material in wastewater.

(4) Inadequate provisions for chain, flight, and sprocket repair and replacement.

(5) Design includes a common sludge removal pipe for two or more clarifiers, resulting in unequal sludge removal from the clarifiers.

(6) Inadequate provisions for sampling of raw sludge.

(7) Operator is not provided with the capability to observe sludge while pumping.

(8) Inadequate flexibility in sludge pumping system.

(9) No provisions for measuring sludge flow.

(10) Inadequate consideration of character of sludge in sizing and layout of sludge lines.

(11) Flushing and cleanout connections for sludge line not provided.

(12) Primary sludge pumps located too far away from clarifiers.

(13) Improper sizing of increments on time clock results in pumping of unnecessarily thin sludge.

c. Scum removal.

(1) Inadequate provisions for preventing frequent maintenance resulting from stringy material in wastewater.

(2) Improper placement of scum removal equipment hinders clarifier performance.

(3) Scum is recycled through the plant and not removed from the system.

(4) Improper selection of scum pumping facilities results in excessive O&M.

9-6. Secondary Treatment Unit Processes

a. Secondary clarification.

(1) No provision for addition of chemicals to improve settling characteristics.

(2) Improper type of sludge removal mechanism selected.

(3) Improper clarifier sidewater depth.

(4) Inadequate access to weirs for sampling and maintenance.

(5) Inadequate consideration of impact and control of in-plant side streams.

(6) Overflow rate (OFR) of clarifiers too high to meet effluent suspended solids limitations.

(7) No provisions for flow division boxes.

(8) Short-circuiting in clarifiers.

(9) Improper weir placement (i.e., proper weir length but closely placed troughs create high, localized upward velocities within clarifier).

(10) Improper length-to-width ratio.

(11) Inadequate or no provisions for scum removal from secondary clarifiers.

(12) Long scum lines frequently become clogged.

(13) Scum will not flow from scum tanks once supernatant is pumped out.

(14) Sludge lines periodically clog, and no back-flush facilities are provided.

(15) Inability to conveniently dewater scum puts.

(16) Inadequate consideration of freezing problems and effect of cold temperatures on efficiency of biological treatment.

(17) Sludge collection equipment inadequately sized.

b. Trickling filter.

(1) General.

(a) Improper design and installation of rotary distribution arms cause clogging and rotation problems.

(b) Side wall not high enough to prevent splashing or aerosol drifting.

(c) Lack of flexibility to flood the filter.

(d) Poor ventilation of filter under drains which may cause odor problems and/or inadequate oxygen for sustainable biological growth.

(e) Clogging of distributor orifices caused by inadequate preliminary or primary treatment.

(f) Inflexibility in flow patterns and/or recirculation strategy.

(g) Inadequate consideration of overspray on filter walls resulting in fly problems.

(h) Inadequate sizing of filter units to meet a more stringent effluent limitations requirement.

(i) Insufficient flow, particularly during low flow conditions, to rotate the distribution arms.

(j) Recirculation of secondary clarifier effluent through filters causes high flows through the clarifier, resulting in clarifier solids carry-over.

(k) No provision for flushing underdrain system.

(l) Inadequate or too frequent recirculating flow to filter causes media plugging.

(2) Rock media.

(a) Improper selection of media without good weathering properties.

(b) Inadequate air circulation provided during periods of high flows.

(c) Inadequate or too frequent recirculating flow to filter causes media plugging.

(d) Ice buildup on filter media.

(3) Plastic media.

(a) Inadequate air circulation provided during periods of high flows.

(b) Inadequate or too frequent flow to filter causes media plugging.

(c) Ice buildup on filter media.

(4) Distribution of wastewater.

(a) Improper design and installation of distribution arms cause clogging and rotation problems.

(b) Lack of flexibility to flood the filter.

(c) Clogging of distributor orifices caused by inadequate preliminary or primary treatment.

(d) Inadequate flow-dosing equipment.

(e) Insufficient flow, particularly during low-flow conditions, to rotate the distribution arm.

(f) Inadequate freeze protection.

(5) Flow recirculation.

(a) Inability to adjust, measure, and control recirculation rate.

(b) Lack of proper recirculation pumping capacity.

(c) Recirculation of secondary clarifier effluent causes high flows through the clarifier, resulting in clarifier solids carryover.

(d) Inadequate consideration of effects of recirculation through primary clarifiers on clarifier loadings.

c. Rotating biological contactors.

(1) Bearings located below grade make RBCs susceptible to flooding.

(2) Buildings not insulated and facility heat losses in winter cause wastewater temperature to drop, thereby reducing biological activity.

(3) Primary clarifiers not provided, causing settling and plugging of media.

(4) Excessive detention time in pre-RBC channels promote the development of septic conditions.

(5) Side streams not accounted for in design of RBC units.

(6) Inadequate screening of raw wastes causes plugging of RBC media.

(7) Inefficient tank design causes dead spots and solids deposition in RBC tank.

(8) Improper design of overflow baffles between stages causes solids deposition.

d. Air activated sludge.

(1) General.

(a) Lack of flexibility to operate in different modes (i.e., complete mix, plug flow, contact-stabilization, etc.).

(b) Aerator spacing not adequately considered.

(c) Inadequate foam control throughout activated sludge basin lengths.

(d) Inadequate mixing prevents solids deposition and uniform suspended solids and dissolved oxygen concentrations throughout the basin.

(e) Inadequate preliminary screening of raw wastes causes plugging of aerators and return/waste sludge pumping system.

(f) Inflexible design does not permit isolation of reactors and changes in flow schemes for maintenance purposes and/or to adjust for changes in wastewater characteristics.

(g) Inadequate consideration of impact and control of in-plant side streams.

(h) Inadequate provisions for bypassing aeration basin for repair.

(i) Improper sidewater depth and baffling cause splashing problems in basin.

(j) Inability to control and measure mixed-liquor flow distribution to multiple secondary clarifiers.

(k) Inadequate consideration of impact of changing aeration basin levels on aerator performance.

(l) Multi-compartmental basins do not have reinforced inner walls; therefore, individual tanks cannot be dewatered.

(m) Inability to drain foam spray system results in freezing problems.

(n) Supports for air drop pipes cannot be seen when aeration basin is full, making it difficult to reinstall the drop pipes.

(o) Inadequate aeration capacity.

(p) Lack of splash shields in front of effluent gates.

(q) Inadequate consideration of freezing problems and effect of cold temperatures on efficiency of biological treatment.

(2) Diffusers.

(a) Inadequate or no air cleaners provided on blowers results in plugging of diffusers.

(b) No provisions for removing air diffuser drop pipes from aeration tanks.

(c) Air valves not graduated to allow even distribution of air flow to diffusers.

(3) Fixed mechanical aerators.

(a) Improper placement of gear box drains causes oil to drain into aeration basin.

(b) Amp meters not provided at motor control center so operators cannot tell if proper amperage is being drawn.

(c) No time delay relays provided to limit stress shock to aerator gears when shifting from high speed to low speed.

(4) Floating aerators.

(a) Floating aerators located too close to wall or pontoons not aligned properly, causing pontoons to strike the basin wall when starting up.

(b) Improper placement of gear box drains causes oil to drain into aeration basin.

(c) Amp meters not provided at motor control center so operator cannot tell if proper amperage is being drawn.

(5) Blowers.

(a) Inadequate or no air cleaners provided on blowers.

(b) Blower silencers not provided.

(6) Dissolved oxygen control and measurement.

(a) Inability to adequately measure and adjust air flow rates to control dissolved oxygen levels and energy consumption.

(b) Improper design of dissolved oxygen measuring instrumentation does not allow easy removal of equipment for routine inspection and maintenance.

(7) Return sludge pumping.

(a) Inadequate provisions for sampling and observation of return and waste-activated sludge.

(b) Improper selection of valves for sludge lines.

(c) Improper return sludge flow splitting.

(d) Inadequate sludge recycle/waste capacity.

(e) Inadequate sludge flow measurement for small plants using air lift pumps.

(f) Inability to adjust, measure, and control return/waste sludge flows due to lack of instrumentation.

(g) Inability to change placement of return sludge in aeration basin.

(h) Scum accumulation in flow splitter boxes.

(8) Waste sludge pumping.

(a) No separate waste sludge pumps.

(b) Inadequate provisions for sampling and observation of return and waste activated sludge.

(c) Improper selection of valves for sludge lines.

(d) Inadequate waste sludge pipe sizing for “slip-stream” wasting.

(e) Inadequate sludge recycle/waste capacity.

(f) Inadequate sludge flow measurement for small plants using air lift pumps.

9-7. Sludge Dewatering

(a) Improper placement of control panels in spray/splash areas hampers clean-up and results in high corrosion rates.

(b) Inadequate consideration of storage of dewatered sludge during inclement weather.

(c) Inadequate consideration of potential plugging problems in sludge piping.

(d) Inadequate consideration of corrosive nature of materials to be handled.

(e) Tank drain lines are located 50-76 mm (2-3 in.) off the bottom of tanks, making it difficult to dewater the basins completely.

(f) Clogging problems in lime piping.

(g) Inadequate provisions for vibration control in sludge piping design.

(h) Sludge pumping and dewatering areas not properly ventilated.

(i) Inadequate provisions for lifting equipment for repairs.

9-8. Non-Conventional Plants

a. Package plants.

(1) Lack of spare pumps.

(2) Lack of walkways around tanks, limiting operator access.

(3) Inadequate flexibility to bypass units.

(4) Inadequate consideration of means to remove equipment for repair or replacement.

(5) Inadequate consideration of scum removal from plant.

(6) Inadequate laboratory facilities for process control.

(7) Inadequate standby equipment.

(8) Inadequate provisions for draining tanks and sumps.

(9) Inadequate scum handling and disposal system.

(10) Foam sprays not concentrated in basin corners where foam buildup occurs.

(11) No provision for water tap at top of above-ground package units.

(12) Use of constant speed pumps where variable-speed units are required.

(13) No provisions made to allow periodic cleaning of the influent wet well.

(14) Samplers frequently clog.

(15) Lack of mud valves in tanks.

(16) Lack of a foam control system.

(17) Absence of electrical outlets on top of treatment units.

(18) Lack of auxiliary power.

(19) Inadequate hand railing and kick plates.

(20) Stairways provided with only one handrail.

(21) Inadequate consideration of noise control.

(22) Inadequate consideration of potential freezing problems of plant components.

b. *Ponds and lagoons*.

(1) Inadequate valving for maximum flexibility and proper maintenance.

(2) Inadequate process flexibility.

(3) Inadequate consideration of access requirements for large equipment (cranes, trucks, etc.) required for maintenance.

(4) Individual flow measurement not provided for each piece of parallel units.

(5) Inadequate consideration of possible development of septic conditions in channels and splitter boxes.

(6) Inadequate provisions for manual valves for emergency conditions.

(7) Inability of process to meet effluent requirements in winter.

(8) Inadequate (or lack of) liner to meet state requirements, and to prevent groundwater pollution.

(9) Single-point entry into pond overloads pond in feed zone.

(10) Lack of multiple cells for operating flexibility.

(11) Anaerobic conditions due to organic overloading.

(12) No drains provided in ponds or lagoons.

(13) Water level gauges not provided.

(14) Improper vertical depth between lagoon bottom and groundwater table.

(15) No groundwater monitoring wells provided.

9-9. Land Application

a. *Overland flow slope design*.

(1) Improper slope construction.

(2) Inadequate detention time on slope to achieve desired level of treatment.

(3) Inappropriate location of land treatment plots.

(4) Inadequate soil depth for suitable land treatment.

(5) Inadequate site loading for optimum treatment.

(6) Inadequate shaping of drainage channels for efficient system operation.

(7) Improper selection of maintenance equipment to minimize soil compaction.

(8) Inadequate location of service roads.

b. *Cover crop*.

(1) Inadequate detention time on slope to achieve desired level of treatment.

(2) Improper selection of maintenance equipment to minimize soil compaction.

c. *Hydraulic application*.

(1) Improper slope construction.

(2) Inadequate soil depth for suitable land treatment.

(3) Inadequate site loading for optimum treatment.

(4) Inadequate knowledge of subsurface drainage alternatives to alleviate drainage problems.

(5) Improper selection of maintenance equipment to minimize soil compaction.

d. *Soil depth*.

(1) Inadequate soil depth for suitable land treatment.

(2) Inadequate consideration given to soil type and the interaction of soil with sodium in the wastewater.

e. Infiltration beds.

(1) Improper slope construction.

(2) Inadequate soil depth for suitable land treatment.

(3) Inadequate construction of lagoons for maintenance and sludge removal.

(4) Inadequate site loading for optimum treatment.

f. Odor control.

(1) Improper slope construction.

(2) Inadequate consideration for needs of pre-chlorination or pre-aeration.

g. Center pivot sprinkler.

(1) Spray nozzles plug due to solids in wastewater.

(2) Inadequate protection of equipment for freezing conditions.

(3) Inadequate pumping facilities for control of sedimentation in piping.

(4) Inadequate facilities provided for flushing of lateral lines.

(5) Inadequate selection of protective coatings to minimize corrosion.

(6) Plastic laterals installed above-ground break because of cold weather.

h. Traveling gun sprinkler.

(1) Spray nozzles plug due to solids in wastewater.

(2) Inadequate pumping facilities for control of sedimentation in piping.

(3) Inadequate facilities provided for flushing of lateral lines.

(4) Inadequate sprinkle head design to minimize aerosolization.

(5) Plastic laterals installed above-ground break because of cold weather.

9-10. Sludge Drying and Disposal

a. Sludge drying beds.

(1) Inadequate drainage system.

(2) No provisions for cake removal from sand bed.

(3) Inadequate provisions for proper sludge distribution.

(4) Inadequate layout of underdrains.

(5) Improper location of sand bed allows inflow of surface drainage.

(6) Inadequate consideration of potential flooding of sand bed.

(7) Improper sand gradation.

(8) Walls dividing sludge drying beds are made of untreated wood and warp rapidly.

(9) Inadequate freeze protection.

(10) Inadequate consideration of local climate on dewatering rate and size requirements for sand beds.

b. *Sludge disposal*.

(1) Inadequate consideration of sludge concentration/transportation tradeoffs.

(2) Inadequate consideration of equipment utility in all-weather conditions.

(3) Lack of vector control.

(4) Inadequate consideration of nutrients and public health hazards (metals, bacteria) transport in soil/groundwater.

(5) Inadequate buffer zone at disposal site.

(6) Lack of odor control/prevention.

(7) Sludge loading delayed due to lack of truck or container capacity.

c. *Composting*.

(1) Inadequate space for sludge staging and preparation.

(2) Inadequate sludge storage during maintenance periods.

(3) Inadequate consideration of feed solids concentration.

(4) Inadequate consideration of fresh air supply and overall ventilation requirements.

(5) Inadequate provisions for reliable auxiliary fuel source.

(6) Inadequate consideration of ultimate residue disposal.

(7) Inadequate odor control.

9-11. Sewer Collection Systems

(a) Failure to specify proper construction materials on sewer lines, e.g., cast iron pipe across creek or when elevated on piers.

(b) Failure to provide vented covers on manholes located on high ground.

(c) Failure to provide tight lids on low-ground manhole covers.

9-12. Lift Stations

(a) Failure to locate lift stations on protected side of streams to reduce possible flooding.

(b) Failure to provide access ladders to all wet wells.

(c) Failure to slope bottoms of all wet wells.

(d) Failure to provide solid covers for wet wells and means of securing same.

(e) Failure to fence lift stations where locations require security.

(f) Failure to provide standby power for lift stations.

(g) Failure to vent all wet wells.

(h) Inadequate consideration of lift station valving.